



# Characterization Report of Bowmans Pond (PAC 700-1108) and Steam Condensate Tanks (IHSS 139.1N)

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**Characterization Report of  
Bowmans Pond (PAC-700-1108) and  
Steam Condensate Holding Tanks (IHSS 139.1N)**

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## 1.0 INTRODUCTION

This closeout report summarizes the field activities and analytical results for the characterization of Bowmans Pond and Individual Hazardous Substance Site (IHSS 139 1N) depositional areas. A description of the Site histories and general area, data summary of previous investigations, 1999 field activities, and 1999 characterization data are presented in this report. Recommendations are presented in the conclusion section (Section 4.0) and are based upon the final analysis and all other available information obtained from this investigation.

The purpose of this investigation was to characterize the potential nature and extent of contamination in surface soil, subsurface soil/sediment, and surface water for Bowmans Pond and surrounding depositional environments adjacent to Bowmans Pond including IHSS 139 1N. In accordance with the Rocky Flats Cleanup Agreement (RFCA) (DOE, 1996a), Bowmans Pond was ranked 28 in the Environmental Restoration (ER) ranking process in September of 1998. The intended use of the pond, its overall location, available analytical data (see Section 1.2) and documented releases in the vicinity were the primary factors involved in the ER ranking process.

Bowmans Pond is referenced as Potential Area of Concern (PAC) 700-1108 in the Historical Release Report (HRR) (DOE, 1992). IHSS 139 1N consists of two empty out of service steam condensate tanks (T-107 and T-108) which are located immediately east of Bowmans Pond and within the Pond's effluent drainage. Together, these Sites and the surrounding area comprise the depositional environment for the northern portion of the 700 Building area. Both areas have been designated under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) as Sites requiring further investigation.

Surface soil, subsurface soil/sediment, and surface water samples were collected from PAC 700-1108 and IHSS 139 1N in April 1999, to characterize the potentially contaminated media and provide the basis for future remedial decisions or a No Further

Action (NFA) determination The field investigation was conducted in accordance with an approved Sampling and Analysis Plan (SAP) (RMRS, 1999a), Health and Safety Plan (HASP), and approved Site procedures Analytical data presented in this report have undergone the appropriate verification and validation process, and have been evaluated with respect to the Action Levels and Standard Framework (ALF) for Surface Water, Groundwater, and Soils (Attachment 5, RFCA, 1996) and Applicable or Relevant and Appropriate Requirements (ARARS) established for the Industrial Area Amendments to RFCA Attachment 5, (standards and action levels), have been used when applicable in this document In summary, there were no compounds identified from this investigation that exceeded (or approached) RFCA Tier I cleanup action levels

### ***1.1 Investigation Area Background and Setting***

Bowmans Pond and the two steam condensate tanks are located within the Protected Area (PA) immediately north of Building 774 and south of the North Patrol Road (Figure 1 1) Bowmans Pond consists of a small manmade depression approximately three to four feet (ft) deep with an areal extent of approximately 28 ft by 33 ft Runoff water from the 700 Building Area enters the pond at several locations through culverts and from one polyvinyl chloride (PVC) pipe Flow estimates range from 0 to 5 gallons per minute during normal weather conditions and increase to approximately 15 gallons per minute during precipitation events The pond discharges to the east, saturating an area approximately 200 feet by 40 feet resulting in a lush wetland depositional environment (including IHSS 139 1N, the fenced area surrounding the steam condensate tanks)

Based upon historical photographs and research identified in the HRR, Bowmans Pond was excavated in 1972 for the purpose of containing storm-water from storm and footing drains in the 700 Area Previous investigations indicate that Bowmans Pond surface water and sediments may have been impacted by run off from upgradient storm and footing drains from Buildings 771 and 774 In addition, an interview with a plant

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## ATTACHMENTS

### Attachment 1 1999 Analytical Data

#### LIST OF ACRONYMS

°C	Degrees Celsius
ALF	Action levels and Standards Framework
ARAR	Applicable or Relevant and Appropriate Requirements
Bgs	Below Ground Surface
CDPHE	Colorado Department of Public Health and Environment
COC	Contaminant of Concern
CRDL	Contract Required Detection Limits
CRQL	Contract Required Quantitation Limits
DER	Duplicate Error Ratio
DOE	U S Department of Energy
DOT	Colorado Department of Transportation
DQA	Data Quality Assessment
DQO	Data Quality Objectives
EPA	U S Environmental Protection Agency
Ft	Foot/Feet
GPS	Global Positioning System
IA	Industrial Area
IHSS	Individual Hazardous Substance Site
LCS	Laboratory Control Sample
mg/Kg	milligrams per kilogram
mg/L	milligrams per Liter
MS	Matrix Spike
MSD	Matrix Spike Duplicate
mV	millivolt
NFA	No Further Action
OPWL	Original Process Waste Line
PA	Protected Area
PAC	Potential Area of Concern
pCi/g	Picocuries Per Gram
pCi/L	Picocuries Per Liter
PCOC	Potential Contaminants of Concern
POC	Point of Compliance
POE	Point of Evaluation
PPE	Personal Protection Equipment
PPRG	Preliminary Programmatic Remediation Goals
PVC	Polyvinyl Chloride
QC	Quality Control
RCT	Radiological Control Technician

RDL	Required Detection Limit
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RFI/RI	RCRA Facility Investigation Remedial Investigation
RMRS	Rocky Mountain Remediation Services, L L C
RPD	Relative Percent Difference
SAP	Sampling and Analysis Plan
SVOC	Semivolatile Organic Compounds
TCLP	Toxicity Characteristic Leaching Process
TPU	Total Propagated Uncertainty
UBC	Under Building Contamination
VOC	Volatile Organic Compounds



Insert figure 1 1

electrician in March of 1999 revealed that a pole mounted transformer was hit by lightning near Bowmans Pond "many years ago" resulting in surficial soil contamination of Polychlorinated Biphenyls (PCBs) PCB contaminated soils were identified in and around Bowmans Pond during a sitewide sampling effort in 1991 Other possible releases to Bowmans Pond resulting from the adjacent steam condensate tanks (IHSS 139 1N) and from an Original Process Waste Line (OPWL) leak are documented in the HRR

The steam condensate tanks (T-107 and T-108) are large aboveground tanks with a capacity of approximately 8,000-gallons each The riveted steel tanks received steam condensate water from a nearby evaporative system and occasionally received liquid from a bermed area surrounding a sodium hydroxide product tank located immediately south and adjacent to Building 774 (Figure 1 1) The structural integrity of both tanks is noted as poor with holes present in the sides and badly corroded bottoms (DOE, 1992)

Bowmans Pond and the steam condensate tanks are located on a northward sloping colluvial surface consisting of approximately 10 to 11 ft of gravelly to sandy clay and silty clay Top of bedrock is approximately 11 ft below ground surface (bgs) and consists of the Laramie Formation claystone The depth to groundwater ranges between six to eight feet and flows in a north-northeast direction towards the apex of North Walnut Creek

## ***1.2 Data Summary from Previous Investigations***

Existing data for surface water, the Building 771 and 774 footing drains, sediment, surface soil, and groundwater from locations in the vicinity of Bowmans Pond, and IHSS 139 1N were compiled for use in identifying the Potential Contaminants of Concern (PCOCs) and data gaps Tables 1 1 through 1 5 present the maximum concentration of each analyte detected by medium sampled

### ***1.2.1 Surface Water***

Analytical results for surface water samples from monitoring locations SW084, SW086, and SW124 are presented in Table 1 1 As presented in Figure 1 2, SW084 and SW124

**Table 1.1 Summary of Maximum Analytical Results – Surface Water**

Location	Date	Description	Result	Unit	Action Level, Segment 5 POE (DOE, 1996)
SW086	4/16/90	1,1,1-Trichloroethane	5	ug/L	200
SW084	5/8/89	Acetone	110	ug/L	3650
SW124	4/17/91	Aroclor-1254	12	ug/L	1 <sup>a</sup>
SW084	4/11/89	Beryllium	3.6	ug/L	4
SW084	3/20/90	Carbon Tetrachloride	130	ug/L	5
SW084	3/20/90	Chloroform	40	ug/L	6
SW084	12/19/89	Chromium	298	ug/L	50
SW084	12/19/89	Cobalt	13.7	ug/L	NA
SW084	12/19/89	Copper, total	216	ug/L	16 (dissolved) <sup>b</sup>
SW084	7/17/90	Cyanide	3	ug/L	5
SW084	12/19/89	Lead, total	189	ug/L	6.5 (dissolved) <sup>b</sup>
SW084	6/26/90	Lithium	1170	ug/L	NA
SW084	12/19/89	Nickel, total	171	ug/L	123 (dissolved) <sup>b</sup>
SW086	6/6/89	Nitrate/Nitrite	25	mg/L	100 (10) <sup>c</sup>
SW086	7/11/88	Oil & Grease	253	mg/L	NA
SW084	6/26/90	Strontium	5850	ug/L	NA
SW086	4/16/90	Tetrachloroethene	5	ug/L	5
SW086	9/10/90	Toluene	10	ug/L	1000
SW084	12/19/89	Zinc	2970	ug/L	141
SW084	2/16/90	Am-241	3.9	pCi/L	0.15 <sup>d</sup>
SW086	10/10/90	Pu-239/240	0.5424	pCi/L	0.15 <sup>d</sup>
SW086	5/7/90	Sr-89/90	9855	pCi/L	8 <sup>d</sup>
SW086	9/10/90	Tritium	1188.96	pCi/L	500 <sup>d</sup>
SW084	5/7/90	U-233/234 <sup>f</sup>	7.98	pCi/L	10 <sup>d,e</sup>
SW086	1/25/90	U-235	0.31	pCi/L	10 <sup>d,e</sup>
SW086	5/7/90	U-238 <sup>f</sup>	6.58	pCi/L	10 <sup>d,e</sup>

Note: Bolded analytes equal or exceed Segment 5, Point of Evaluation (POE) action levels

- a) The practical quantitation limit (PQL) for Aroclor-1254 (1 ug/L) is greater than the action level (0.5 ug/L). Per RFCA, the action level defaults to the PQL.
- b) Measured concentration is for an unfiltered sample, the action level is for a filtered sample.
- c) 100 mg/L is an interim standard.
- d) The action level is a site-specific standard for Walnut Creek.
- e) The action level is for a total U measurement rather than isotopic.
- f) Adding the U-233/234 and U-238 activities for the sample collected from 5/7/90 results in a total activity exceeding the action level.

insert Figure 1 2

are located upgradient of the pond and are representative of groundwater and surface water inflow to Bowmans Pond from the surrounding area. Monitoring station SW086 is located downgradient of the pond and, although data is limited, was used to estimate water quality from Bowmans Pond. The maximum concentrations of contaminants detected at these locations were compared to surface water action levels and standards for the Segment 5, Point of Evaluation (POE) provided in Attachment 5 of RFCA (DOE, 1996a). Analytes with maximum concentrations exceeding the referenced action levels are bolded in Table 1.1 and represent the PCOCs.

### **1.2.2 Footing Drains**

The footing drain and storm drain waters from Buildings 771 and 774 have been routinely released to Bowmans Pond and, as a result, represent a potential source of contamination to the pond and surrounding area. Figure 1.2 illustrates the two footing drain locations (FD-774-1 and FD-774-2) and the remaining two culverts. Analytes detected in samples collected from footing drain FD-774-1 previous to and during the OU 8 investigation (EG&G, 1994) are presented in Table 1.2. Comparability in the occurrence and concentrations of tritium, lead, chromium, copper, strontium, and zinc between surface water and the footing drain water is noted. Analyte concentrations appear to decrease between the 1989 and the 1993 sampling events. No flow was observed in footing drain FD-774-2 during the sampling events shown in Table 1.2.

### **1.2.3 Sediment and Surface Soil**

Sediment monitoring location SED124 corresponds with surface water monitoring location SW124 (Figure 1.2) and is located upgradient of Bowmans Pond. The analytical results for SED124 are presented in Table 1.3. The results indicate elevated levels of PCB Aroclor-1254, benzo(a)pyrene and dibenzo(a,h)anthracene as compared to RFCA Tier II surface soil action levels for the Industrial Area (IA) however, all are below the Tier I action levels. Radionuclides are observed in the range of 0.1 to 2.2 pCi/g. Tritium, measured in the interstitial water from the sediment samples, was observed at a maximum of 794.7 pCi/L.

**Table 1 2 - Summary of Maximum Analytical Results for  
Footing Drain - FD 774-1**

Date	Description	Result	Units	Action Level, Segment 5 POE
Jun-80	Tritium	4,681	pCi/L	500
Jun-80	Nitrate as Nitrogen	108 5	mg/L	100
4/26/89	Lead	363	ug/L	6 5 (dissolved)
4/26/89	Chromium	54	ug/L	50
4/26/89	Copper	360	ug/L	16 (dissolved)
4/26/89	Nickel	71	ug/L	123 (dissolved)
4/26/89	Strontium	700	ug/L	NA
4/26/89	Zinc	7,300	ug/L	141
3/27/93	Lead	6	ug/L	6 5 (dissolved)
3/27/93	Chromium	<5	ug/L	50
3/27/93	Copper	12	ug/L	16 (dissolved)
3/27/93	Nickel	<13	ug/L	123 (dissolved)
3/27/93	Strontium	274	ug/L	NA
3/27/93	Zinc	154	ug/L	141

Note: Bolded analytes equal or exceed Segment 5, Point of Evaluation (POE) Action Levels. No VOCs or SVOCs were detected in the March 1993 sampling event.

**Table 1.3 - Summary of Maximum Analytical Results  
from Sediment Monitoring Station (SED124)**

Date	Description	Result	Unit	Surface Soil/Industrial	
				Tier II	Tier I
3/25/91	4-Nitroaniline	5 3	mg/Kg	NA	NA
3/25/91	Americium-241	0 8585	pCi/g	38	209
3/25/91	Anthracene	2 9	mg/Kg	613,000	613,000
12/17/90	Antimony	7	mg/Kg	818	818
3/25/91	Aroclor-1254	67	mg/Kg	0 743	74 3
4/16/91	Arsenic	5 1 <sup>a</sup>	mg/Kg	3 27	327
3/25/91	Benzo(a)Anthracene	7 1	mg/Kg	7 84	784
3/25/91	Benzo(a)Pyrene	6.3	mg/Kg	0 784	78 4
3/25/91	Benzo(b)Fluoranthene	7 1	mg/Kg	7 84	784
3/25/91	Benzo(ghi)Perylene	5 7	mg/Kg	NA	NA
3/25/91	Benzo(k)Fluoranthene	6 3	mg/Kg	78 4	7840
8/20/91	Beryllium	0 86	mg/Kg	1 33	133
4/16/91	Cesium-134	0 1187	pCi/g	NA	NA
12/17/90	Chromium	49 5	mg/Kg	>1E+6	>1E+6
3/25/91	Chrysene	8 2	mg/Kg	784	78400
9/19/90	Dibenzo(a,h)Anthracene	1 2	mg/Kg	0 784	78 4
3/25/91	Indeno(1,2,3-cd)Pyrene	5	mg/Kg	7 84	784
3/25/91	Phenanthrene	16	mg/Kg	NA	NA

3/25/91	Plutonium-239/240	1 129	pCi/g	252	1088
3/25/91	Pyrene	19	mg/Kg	61300	613
4/16/91	<b>Radium-226</b>	2 2	pCi/g	0 0247	2 47
4/16/91	Selenium	0 94	mg/Kg	1 02E+04	1 02E+04
4/16/91	Strontium	53	mg/Kg	>1E+6	>1E+6
3/25/91	Strontium-89,90	0 1378	pCi/g	57 2	5720
3/25/91	<b>Tritium</b>	794 7 <sup>b</sup>	pCi/L	44800	4 48E+06

Note: Bolded analytes exceed Tier II surface soil action level for Industrial Use

- a) The arsenic concentration is above the Action Level but is below background
- b) Tritium value exceeds surface water Action Level, Tritium sample collected from interstitial water from sediment sample

Five sediment samples (SED80293 through SED80693) were collected from the areas around the two steam condensate tanks as part of the OU 8 Phase I RCRA Facility Investigation Remedial Investigation (RFI/RI) as shown in Figure 1 2 (EG&G, 1995a). The sediment samples were analyzed for metals and volatile organic compounds (VOCs) and all results were below the Tier II ALF values for the respective analytes (EG&G, 1995b).

As a result of the elevated Aroclor-1254 concentration detected at SED124 (67 mg/Kg), PCB occurrences in the area were investigated further as part of a follow up investigation in May 1991. Sample locations are shown on Figure 1 2 and the results are summarized in Table 1 4 (EG&G, 1991). A maximum concentration of 8,700 ug/Kg Aroclor-1254 was observed at site PCB31-13 near the influent of Bowmans Pond (Figure 1 2). Overall, seven of the samples had Aroclor-1254 concentrations above the Tier II value.

**Table 1.4 - Summary of PCB Analytical Results  
for Soils, May 1991**

Location	Aroclor-1254 (ug/Kg)
PCB31-6	25
PCB31-7	33
PCB31-8	< 21
PCB31-9	230
<b>PCB31-10</b>	<b>1,500</b>
<b>PCB31-11</b>	<b>3,700</b>
<b>PCB31-12</b>	<b>1,600</b>
<b>PCB31-13</b>	<b>8,700</b>
<b>PCB31-14</b>	<b>4,300</b>
PCB31-15	220
<b>PCB31-16</b>	<b>2,300</b>
<b>PCB31-17</b>	<b>1,800</b>

Note: < = Analyte not detected at or above the listed method reporting limit, (EG&G, 1991). Bolded sample locations indicate the analyte exceeded the Tier II Action Level for Aroclor-1254, which is 743 ug/Kg.

#### 1.2.4 Groundwater

Groundwater data in the vicinity of Bowmans Pond and IHSS 139 1N are limited. The maximum concentrations of PCOCs detected from November 1993 through June 1998 from monitoring well P219189, which is located upgradient of Bowmans Pond (Figure 1 2), are presented in Table 1 5. Only results for VOCs and tritium were available.

The Solar Pond Interceptor Trench System (ITS) (RMRS, 1999b) captures a portion of the groundwater downgradient from Bowmans Pond and the two Steam Condensate Tanks. Groundwater contamination, observed in well P219189, is a result of upgradient sources from the Industrial Area and will be addressed by the Industrial Area contaminant plume remedial action.

**Table 1.5 -Summary of Maximum Analytical Results from Groundwater (Well P219189)**

Date	Description	Result	Units	Tier II	Tier I
11/18/93	1,1,1-Trichloroethane	12	ug/L	200	20000
6/15/98	1,1,2-Trichloroethane	1	ug/L	5	500
11/18/93	1,1-Dichloroethane	58	ug/L	1,010	101000
11/18/93	1,1-Dichloroethene	49	ug/L	7	700
2/8/94	1,2-Dichloroethane	0.3	ug/L	5	500
8/10/94	1,2-Dichloropropane	0.7	ug/L	5	500
6/15/98	<b>Carbon Tetrachloride</b>	7	ug/L	5	500
6/15/98	Chloroform	2	ug/L	100	10000
6/15/98	Cis-1,2-Dichloroethene	1	ug/L	70	700
6/15/98	Methylene Chloride	2	ug/L	5	500
11/20/95	Nitrate/Nitrite	0.92	ug/L	10000	1000000
6/15/98	Tetrachloroethene	0.6	ug/L	5	500
8/10/94	Trichloroethene	0.4	ug/L	5	500
8/10/94	<b>Tritium</b>	990	pCi/L	666	66600

Note: Bolded analytes exceed Tier II groundwater action levels.

Table 1 6 presents a summary of the PCOCs identified using the available historical data. The above sections referring to historical data show that surface soils and subsurface soils are known to be contaminated with Aroclor-1254 above RFCA Tier II action levels. An "N/A" on Table 1 6 indicates that the medium was not analyzed for. In reviewing the historical data, the most significant data gaps for Bowmans Pond and the steam



condensate tanks were identified for surface and subsurface soils. Surface soils in the area had only been characterized for PCBs and subsurface soil had not been sampled. Additionally, given the age of the analytical results presented for surface water, sediments, and surface soil, these samples likely are not representative of current conditions in the area. The data accumulated from previous investigations were not sufficient to characterize the extent or magnitude of the contamination at the site, therefore, future decisions regarding the disposition of Bowmans Pond and IHSS 139 1N area (e.g., accelerated action, interim action, no further action) could not be made without additional sampling.

**Table 1.6 - Summary of Available Data and Resulting PCOCs by Media for Bowmans Pond and IHSS 139.1N**

PCOC	Media				
	Surface Water	Footing Drain	Sediment	Surface Soil	Groundwater
Aroclor-1254	X	N/A	X	X	N/A
Benzo(a)pyrene	ND	ND	X	N/A	N/A
Carbon Tetrachloride	X	ND	ND	N/A	X
Chloroform	X	ND	ND	N/A	ND
Chromium	X	X	X	N/A	N/A
Copper	X	X	ND	N/A	N/A
Lead	X	X	ND	N/A	N/A
Nickel	X	X	ND	N/A	N/A
Nitrate	X	X	ND	N/A	N/A
1,1-DCE	ND	ND	ND	N/A	X
Tetrachloroethene	X	ND	ND	N/A	ND
Zinc	X	X	ND	N/A	N/A
Am-241	X	N/A	X	N/A	N/A
Pu-239/-240	X	N/A	X	N/A	N/A
Ra-226	ND	N/A	X	N/A	N/A
Sr-89/-90	X	N/A	X	N/A	N/A
Tritium	X	N/A	X	N/A	N/A

Note: X = Data is available, N/A = No data available, ND = Data indicates no detection's

## 2.0 CHARACTERIZATION SAMPLING

This section describes the field activities, sampling techniques and methodologies per the Sampling and Analysis Plan (SAP) for the Site Characterization of Bowmans Pond (PAC 700-1108) and the Steam Condensate Holding Tanks (IHSS 139 1N), (RMRS, 1999a) Field sampling activities took place between April 20 and 28, 1999

### 2.1 Methodology

Eleven surface and subsurface soil/sediment sample locations were selected to further characterize the investigation area (see Figure 2 1) The eleven soil coring locations were selected on the basis of 1) influent areas, 2) center of the pond, 3) effluent areas, and 4) the depositional areas located down gradient of the pond and steam condensate tanks At each sample location, surface and subsurface intervals of the sediment were collected and analyzed for VOCs, SVOCs, total metals, PCB/Pesticides, tritium, radionuclides, and radiological screens The required number of Quality Control (QC) samples (i e , duplicates, rinsates, and trip blanks) were collected and analyzed in accordance with the approved SAP (RMRS, 1999)

### 2.2 Soil Borings and Pond Sediment Sampling

Surface soil sampling (from 0 0 to 0 5 ft bgs) and subsurface soil sampling from 0 5 ft to the total achievable depth (total depth varied, see Table 2 1) was conducted at 11 locations within the investigation area Sample cores were logged in accordance with procedure RMRS/OPS-PRO 101, *Logging Alluvial and Bedrock Material* The sample locations are identified as BH10199 through BH11199 (Figure 2 1) Each sample location was staked at the time of sampling and a Global Positioning Satellite (GPS) survey of the sample locations was performed on April 28, 1999 Borehole logs are included in Attachment 1

INSERT FIGURE 2 1 HERE

**Table 2.1 - 1999 Soil/Sediment Sampled Intervals**

Sample Location	VOA Intervals – Grab (in feet BGS)	Composited Intervals (in feet BGS)
BH10199	1 2-1 4	0-0 5, 0 5-1 5
BH10299	2 0-2 2	0-0 5, 0-0 5 DUP, 0 5-1 1, 0 5-1 1DUP
BH10399	1 8-2 0, 2 0-2 2 DUP	0-0 5, 0 5-1 5, 0 5-1 5 DUP
BH10499	1 6-1 9, 2 5-2 75	0-0 5, 0 5-1 5, 1 9-2 5
BH10599	2 0-2 2	0-0 5, 0 5-1 5
BH10699	1 65-1 85, 2 8-3 0	0-0 5, 0 5-1 5, 2 0-3 0
BH10799	2 3-2 5, 3 45-3 65	0-0 5, 0 5-1 5, 2 0-3 5
BH10899	1 5-1 7, 2 7-2 9	0-0 5, 0 5-1 5, 2 0-3 0
BH10999	1 5-2 0, 3 5-4 0	0-0 5, 0 5-1 5, 2 0-3 0
BH11099	1 5-2 0, 2 5-2 8	0-0 5, 0 5-1 5, 2 0-2 8
BH11199	1 8-2 15, 2 2-2 4	0-0 5, 0 5-1 5, 1 9-2 4

Soil cores were collected using a hand held, zero contamination, driver corer as described in procedure RMRS/OPS-PRO 064, *Pond and Reservoir Bottom Sediment Sampling*. In most cases the stainless steel core barrel was driven with a metal slide hammer to sample the desired interval, sufficient depth, or until refusal. In some instances it became necessary to collect a sediment interval with a stainless steel hand auger. Sample intervals collected at the eleven locations consisted of grab samples for VOCs (non-composited) and composite samples for SVOCs, total metals, PCB/Pesticides, tritium, radionuclides, and radiological screens. For sample locations BH11099 and BH11199, soil pH composite samples were also collected. Several sampling attempts (as many as five) were required at most sample locations (in immediately adjacent locations) to acquire sufficient sample volume for the various analyses. Sample location BH10999, located near the center of the pond, required the use of an aluminum boat with a center sampling port to collect the pond sediments.

The sample intervals for each of the eleven locations varied slightly in depth due to refusal from gravel fills, compaction of sediment within the core barrel and/or field supervisory judgement. Multiple cores were frequently sampled in immediately adjacent locations to obtain, as possible, the intervals specified in the SAP. As a result, grab and

composite intervals occasionally overlapped. The specific intervals sampled at each coring location are shown in Table 2.1

### 2.3 Surface Water Sampling

Surface water samples from Bowmans Pond were collected to characterize variability in water chemistry throughout the pond and to compare current to previous water quality information. Two separate sampling events were conducted during which surface water sampling was performed.

The two sampling events are described as follows:

- A normal (or base level) sampling event during which runoff and flow conditions in the vicinity of the pond were considered to be representative of average conditions occurred on April 20, 1999.
- A storm sampling event took place on April 22, 1999 after a light snowfall resulted in above average storm water runoff into the pond. Meteorological records show that 1.28 inches of precipitation resulted from the snowfall.

For each sampling event, surface water samples were collected at the following locations: One sample from an inflow location (near BH10899 in the southwest corner of the pond), one sample from the center of the pond (near BH10999), and one sample from an outflow location (near BH10599 in the northeast corner of the pond) (see Figure 2.1).

Surface water samples were collected as described in procedure RMRS/OPS-PRO 085, *Pond Sampling (Section 5.4.2.2) for Small Pond Sampling from Shore*. Surface water quality field parameters were collected as described in procedure RMRS/OPS-PRO 081, *Surface Water Sampling* and recorded per procedure RMRS/OPS-PRO 126, *Surface Water Data Collection Activities* which included sample temperature, Eh, pH, and specific conductance.

### 2.4 Analytical Results

Sample analyses were conducted in accordance with the procedures required by the SAP (RMRS, 1999). Sample Correlation and Chain of Custody Forms along with the data

packages for the analytical results are presented in Attachment 1. In accordance with the SAP, 25% of the analytical data obtained for the project was submitted for validation. In addition, all of the analytical data has been verified and entered into the Soil and Water Database (SWD).

Analytical data was reviewed and compared to Tier I and Tier II RFCA Action Levels (ALF), Attachment 5, as amended (DOE, 1996a). For the purpose of summarizing the data in this text, only the analytes reported as greater than their respective RFCA Tier II action levels are discussed. Methylene Chloride and Acetone were reported at concentrations well below Tier II Action Levels and are justified as laboratory contaminants hence requiring no further evaluation. All other analytes, detected or non-detected, are not discussed in the text of this report, however they are presented in Attachment 1.

#### **2.4.1 Soils**

Five analytes (or PCOCs) were identified in surface and subsurface soils near or above Tier II RFCA Action Levels in the investigation area. They are, Benzo(a) Pyrene, Dibenzo(a,h)anthracene, Aroclor-1254, Tritium and Arsenic and are discussed individually below. Radiological analysis results are also presented and discussed in this section.

**PCBs** - Aroclor-1254 concentrations ranged from below detection to 68 mg/kg and are presented in Table 2.2. This range of values is both well below and somewhat above the Tier II action level for surface soils of 2.86 mg/kg (industrial land use). All of these values are well below the Tier I action level of 286 mg/kg. The areas in which the levels of Aroclor-1254 exceed the Tier II levels are predominately within the soils/sediments upgradient of and within the influent, center, and south sediments of the pond. With the exception of the 0.5 to 1.5 ft interval from sample location BH11099, the sediments sampled in the effluent area and areas down gradient of the pond were all reported as being less than the Tier II threshold. The distribution of Aroclor-1254 within the surface and shallow subsurface intervals of the investigation area sediments reconfirms the same level of contamination initially identified in the 1991 sampling investigation (see Tables 1.3 and 1.4).

**Table 2.2 1999 Summary of Aroclor-1254 Detections**

Borehole No	Sample Depth Interval (ft BGS)	Sample ID 99A68	Aroclor-1254 (mg/Kg)	Lab Qualifier
RFCA Tier II Action Level <sup>1</sup>			2 86	
RFCA Tier I Action Level <sup>1</sup>			286	
BH10199	0-0 5	47-001	0 078	
	0 5-1 5	48-001	0 084	U
BH10299	0-0 5	47-002	0 21	U
	0-0 5 DUP	47-004	0 19	U
	0 5-1 1	48-002	0 073	
	0 5-1 1 DUP	48-012	0 18	
BH10399	0-0 5	47-003	0 21	
	0 5-1 5	48-003	0 21	U
	0 5-1 5 DUP	48-013	0 15	
BH10499	0-0 5	47-013	68	
	0 5-1 5	48-026	57	
	1 9-2 5	48-027	7 7	
BH10599	0-0 5	47-005	0 76	
	0 5-1 5	48-005	0 67	
BH10699	0-0 5	47-007	4.3	
	0 5-1 5	48-014	0 071	
	2 0-3 0	48-015	0 32	
BH10799	0-0 5	47-008	14	
	0 5-1 5	48-016	14	
	2 0-3 5	48-017	2 1	
BH10899	0-0 5	47-011	8 4	
	0 5-1 5	48-022	4 5	
	2 0-3 0	48-024	0 39	
BH10999	0-0 5	47-014	19	
	0 5-1 5	48-028	31	
	2 0-3 0	48-029	16	
BH11099	0-0 5	47-015	0 45	
	0 5-1 5	48-030	13	
	2 0-2 8	48-031	0 34	
BH11199	0-0 5	47-016	0 27	U
	0 5-1 5	48-032	0 086	U
	1 9-2 4	48-033	0 087	U

<sup>1</sup>RFCA Action Level represents the value used for Industrial Use Surface Soil

**Tritium** - The reported values of tritium in soils and their estimated errors are presented in Table 2.3. These concentrations range from 170 to 1300 pCi/L. There are no associated RFCA action levels for tritium in soils currently available to compare these values against; however, PPRG values for an office worker exposure scenario are 44,700 pCi/g representing a  $10^{-6}$  carcinogenic risk. Assuming a worst case scenario of 50% soil saturation, conversion calculations estimate that for this example, 1300 pCi/L is equivalent to 0.43 pCi/g. It should be noted that the laboratories are required by contract to report tritium values for soils in units of pCi/L (as opposed to pCi/g).

**Semi-volatile Organics** - Benzo(a)pyrene and Dibenzo(a,h)anthracene were the only reported semi-volatile organic compounds detected in the investigation area soil and sediments. All reported values for these two compounds are presented in Table 2.3. The reported concentrations of benzo(a)pyrene and dibenzo(a,h)anthracene range from non-detection to 6400 µg/Kg and non-detection to 1600 µg/Kg, respectively. The sediments within seven of the eleven borehole locations exceeded the RFCA Tier II action level of 784 µg/Kg for benzo(a)pyrene. The sediments from two boreholes exceeded the RFCA Tier II action level for dibenzo(a,h)anthracene. Both compounds are well below the RFCA Tier I action level of 78,400 µg/Kg, for each compound.

**Total Metals** - The reported values for arsenic in soils range from 1.5 to 9.5 mg/kg as presented in Table 2.3. The Tier II action level for arsenic is 3.81 mg/kg (RFCA action levels for metals are the same for surface and subsurface soils). The Site-wide mean plus two standard deviations background concentration of arsenic in surface soils is 10.09 mg/kg (EG&G, 1995). All reported values for arsenic in soils fall below this value.

**Radionuclides** - Table 2.4 presents the radiological activities reported in soils. The collected soil intervals were analyzed for the following isotopes: U-233/234, U-235, U-238, Pu-239/240, and Am-241. Since more than one radionuclide is present in the soils, a "Sum of Ratios" method was used to assess any potential for remedial actions (DOE, 1996b). For each sampled interval, the reported activities for each radionuclide were divided by their respective Tier II action levels and a sum of their ratios was calculated.



**Table 2 3 – 1999 Summary of Tritium, SVOCs, and Metals Detections in Soils**

Borehole No	Sample Depth Interval (ft BGS)	Sample ID 99A68	Benzo(a) pyrene (ug/Kg)	Dibenzo(a,h) anthracene (ug/Kg)	Arsenic <sup>2</sup> (mg/Kg)	Tritium <sup>3</sup> (pCi/L)	
RFCA Tier II Action Level <sup>1</sup>			784	784	3.81	Reported	Error
RFCA Tier I Action Level <sup>1</sup>			78,400	78,400	381	Value	Estimate
BH10199	0-0.5	47-001	<380 U	<380 U	3.7	380	170
	0.5-1.5	48-001	<420 U	<420 U	6.5	230	170
BH10299	0-0.5	47-002	<410 U	<410 U	4.0	470	180
	0-0.5 DUP	47-004	<380 U	<380 U	1.5	530	180
	0.5-1.1	48-002	<370 U	<370 U	1.8	370	190
	0.5-1.1 DUP	48-012	120 J	39 J	3.5	310	180
BH10399	0-0.5	47-003	110 J	<460 U	5.0	750	200
	0.5-1.5	48-003	49 J	<410 U	3.5	470	190
	0.5-1.5 DUP	48-013	41 J	<400 U	3.6	360	180
BH10499	0-0.5	47-013	6400	1600 J	4.3	400	170
	0.5-1.5	48-026	760	140 J	7.1	290	170
	1.9-2.5	48-027	77 J	<440 U	6.1	320	170
BH10599	0-0.5	47-005	<450 U	<450 U	3.4	500	180
	0.5-1.5	48-005	46 J	<390 U	4.7	320	180
BH10699	0-0.5	47-007	240 J	60 J	9.5	290	170
	0.5-1.5	48-014	<440 U	<440 U	4.7	420	170
	2.0-3.0	48-015	<480 U	<480 U	5.3	510	190
BH10799	0-0.5	47-008	730	150 J	5.4	380	180
	0.5-1.5	48-016	390 J	77 J	5.9	400	190
	2.0-3.5	48-017	180 J	36 J	5.1	210	170
BH10899	0-0.5	47-011	1100	250 J	5.3	460	180
	0.5-1.5	48-022	230 J	45 J	5.4	170	160
	2.0-3.0	48-024	<430 U	<430 U	6.3	370	180
BH10999	0-0.5	47-014	1100 J	320 J	6.2	1000	210
	0.5-1.5	48-028	3200 J	830 J	6.4	1100	230
	2.0-3.0	48-029	1400	330 J	6.7	1300	240
BH11099	0-0.5	47-015	860	220 J	6.2	370	160
	0.5-1.5	48-030	39 J	<420 U	5.6	520	190
	2.0-2.8	48-031	40 J	<440 U	5.3	740	200
BH11199	0-0.5	47-016	1200 J	330 J	3.1	500	180
	0.5-1.5	48-032	570	160 J	3.6	710	200
	1.9-2.4	48-033	68 J	<440 U	2.3 B	650	200

<sup>1</sup>RFCA Action Level represents the value used for Industrial Use Surface Soil

<sup>2</sup>Site-wide mean value for background concentration of arsenic in surface soils is 6.09 mg/Kg

<sup>3</sup>No RFCA Action Levels have been established for Tritium concentrations in soils

Table 2 4 shows the highest calculated sum of ratios for any sample is 0 07 The Tier II action level is not exceeded since the sum of ratios is less than 1 0

#### **2 4 2 Surface Water**

Volatile organic compound and radiological analytes detected in the three surface water locations at concentrations approaching or above their respective Tier II action levels include carbon tetrachloride and tritium Although present in the surface water of Bowmans Pond, these contaminants are not identified above RFCA action levels in down gradient Point of Evaluation (POE) and Point of Compliance (POC) monitoring stations The contaminants are discussed in the following sections Surface water field parameters are presented in Table 2 5

**Volatile Organic Compounds** - The concentrations of carbon tetrachloride detected from the two sampling events (normal and storm) for surface water range from 0 005 to 0 021 mg/L as presented in Figure 2 2 These concentrations are at or above the respective RFCA action level of 0 005 mg/L The reported values suggest a general decrease in concentrations from the inflow to the outflow areas of the pond as well as an overall decrease in concentrations during the normal event to the storm event conditions The decrease in concentration is assumed to be due to a dilution effect of influent waters with the larger volume of water contained within the pond The source of carbon tetrachloride has not been identified, however groundwater monitoring data has identified a volatile organic plume upgradient of the investigation area One assumption is that contaminated groundwater from a known upgradient source (IHSS 118 1) is entering the Building 771 and 774 footing drains and discharging to Bowmans Pond

**Tritium** - The reported concentrations of tritium in the surface waters sampled from Bowmans Pond range from 180 to 510 pCi/L as shown in Table 2 6 The RFCA action level established for Woman Creek and Walnut Creek, the two main surficial watershed drainages from the Site, is 500 pCi/L As noted in Table 2 6, all reported values fall below this action level with the exception of sample 99A6845-004 (the East location duplicate sample) which was reported at 510 pCi/L with an estimated error of 180 pCi/L

Insert Figure 2 2

**Table 2.4 1999 Summary of Radionuclide Data for Soils  
(compared to RFCA Tier II action levels)**

RIN Number	Reported Activity (pCi/g)					Sum of Ratio (pCi/g)	Borehole/ Interval
	U-233/234	U-235	U-238	PU-239/240	AM-241		
Tier II Action Level (pCi/g)	307	24	103	252	38		
99A6847 001 007	0 846	0 032	1 12	0 14	0 104	0 02	10199 0-0 5
99A6847 002 006	0 791	0	0 73	0 075	0 129	0 01	10299 0-0 5
99A6847 003 006	1 02	0	0 656	0 212	0 077	0 01	10399 0-0 5
99A6847 004 005	0 871	0 078	1 04	0 267	0 015	0 02	10299 0-0 5 DUP
99A6847 007 007	1 12	0 087	1 07	0 416	0 3	0 03	10699 0-0 5
99A6847 008 007	0 924	0 035	0 792	0 747	0 373	0 02	10799 0-0 5
99A6847 011 006	0 981	0 016	0 738	0 263	0 197	0 02	10899 0-0 5
99A6847 012 002	1 58	0 051	1 74	0 153	0 061	0 03	10599 Retake
99A6847 013 006	0 718	0 057	0 768	1 42	0 8	0 04	10499 0-0 5
99A6847 014 006	1 18	0 02	0 974	1 36	0 433	0 03	10999 0-0 5
99A6847 015 006	0 875	0 123	1 03	0 103	0 199	0 02	11099 0-0 5
99A6847 016 006	0 947	0 029	0 954	0 619	0 677	0 03	11199 0-0 5
99A6848 001 005	0 764	0 078	0 911	0 166	0 202	0 02	10199 0 5-1 5
99A6848 002 005	1 07	0 018	0 757	0 31	0 108	0 02	10299 0 5-1 1
99A6848 003 005	0 813	0 031	0 947	0 334	0 185	0 02	10399 0 5-1 5
99A6848 005 005	0 825	0 106	0 756	0 32	0 18	0 02	10599 0 5-1 5
99A6848 012 005	0 916	0 032	0 874	0 26	0 16	0 02	10299 0 5-1 1 DUP
99A6848 013 005	1 24	0 061	0 919	1 48	0 33	0 03	10399 0 5-1 5 DUP
99A6848 014 006	1 03	0 018	1 16	0 007	0 078	0 02	10699 0 5-1 5
99A6848 015 006	0 945	0 033	0 941	0 008	-0 055	0 01	10699 2 0-3 0
99A6848 016 006	0 721	0 018	0 94	0 262	0 139	0 02	10799 0 5-1 5
99A6848 017 006	1 03	0 053	1 03	0 098	0 068	0 02	10799 2 0-3 5
99A6848 022 006	0 984	0	0 945	0 353	0 07	0 02	10899 0 5-1 5
99A6848 024 006	0 71	0 033	1 16	0 192	0 261	0 02	10899 2 0-3 0
99A6848 026 006	1 1	0 051	1 34	0 875	0 587	0 04	10499 0 5-1 5
99A6848 027 006	0 891	0 017	1 1	0 18	0 15	0 02	10499 1 9-2 5
99A6848 028 006	1 29	0 048	1 69	1 87	1 47	0 07	10999 0 5-1 5
99A6848 029 006	0 944	0 05	1 49	0 652	0 461	0 03	10999 2 0-3 0
99A6848 030 006	1 21	0 017	1 34	0 018	0 057	0 02	11099 0 5-1 5
99A6848 031 006	1 49	0 054	1 17	0 015	-0 016	0 02	11099 2 0-2 8
99A6848 032 006	0 991	0 108	0 855	0 283	0 053	0 02	11199 0 5-1 5
99A6848 033 006	0 83	0 093	0 976	0 026	0 007	0 02	11199 1 9-2 4
Worst Case Scenario Using Maximum Concentrations	1 58	0 123	1 74	1 87	1 47	0 07	n/a

**Table 2.5 1999 Surface Water Field Parameters**

Sample Location	Date Sampled	Time Sampled	Ph	Specific Conductivity	Eh (mV)	Temp Air, Temp H <sub>2</sub> O (°C)	Nitrate (mg/L)	DO (mg/L)
<b>Normal Event 4/20/99</b>								
East (Outflow)		15 03	7 53	0 68	131 5	23 9, 15 2	7 7	NA <sup>1</sup>
Near Center of Pond		14 44	NA <sup>1</sup>	NA <sup>1</sup>	NA <sup>1</sup>	NA <sup>1</sup>	NA <sup>1</sup>	4 8
West (Inflow)		15 15	8 15	0 574	120 5	21 0, 16 2	4	NA <sup>1</sup>
South Center Edge of Pond <sup>2</sup>		14 52	NA <sup>1</sup>	NA <sup>1</sup>	NA <sup>1</sup>	NA <sup>1</sup>	NA <sup>1</sup>	4 1
<b>Storm Event 4/22/99</b>								
East (Outflow)		13 15	7 12	0 294	107 5	12 0, 5 6	1 6	8 4
Near Center of Pond		13 30	7 64	0 22	107 9	11 1, 4 8	2 4	8 5
West (Inflow)		13 45	7 95	0 201	105 9	10 2, 7 4	1 4	8 1

<sup>1</sup>NA = Field parameters not collected due to close proximity of pond inflow and outflow locations

<sup>2</sup>Additional Dissolved Oxygen collected during Normal Event

**Table 2.6 - 1999 Tritium Concentrations in Surface Water**

RIN 99A68	Location in Pond	Tritium pCi/L	Error Estimate
<b>Action Level</b>		<b>500</b>	
<b>Normal Event</b>			
045 001	East (Outflow)	430	170
045 002	Middle	490	180
045 003	West (Inflow)	390	170
045 004	East DUP	510	180
<b>Storm Event</b>			
046 002	East (Outflow)	180	150
046 003	Middle	390	170
046 004	West (Inflow)	320	160

**Radionuclides** - The concentrations of radionuclides detected in Bowmans Pond surface water are presented in Table 2 7 For surface water, each radionuclide was analyzed separately and compared to its respective RFCA action level established for Woman and Walnut Creeks (DOE, 1996)

Total uranium concentrations (the sum of U-233/234, U-235, and U-238) reported for surface water range from 0 to 4 94 pCi/L This range falls well below the action limit of 10 pCi/L established for Walnut Creek surface water Concentrations for Pu-239/240 and Am-241 range from 0 to 0 184 and 0 to 0 098 pCi/L, respectively A concentration of

0 184 pCi/L for Pu-239/240 was observed in one sample from the East (outflow)  
sampling location of the pond during the normal sampling event

As indicated in Table 2 7, normal event radionuclide activities were, in general, higher than activities during the storm event sampling This suggests that surface runoff does not significantly contribute to radiological contamination in the pond water An example of this is shown for the one exceeded value for Pu-239/240 of 0 184 pCi/L reported during normal sampling conditions and its corresponding storm event value reported at 0 093 pCi/L

**Table 2.7 1999 Summary of Radionuclide Data for Surface Water**

RIN Number	Reported Activity (pCi/L)						Sample Location
	U-233/234	U-235	U-238	U-Total	PU-239/240	AM-241	
Action Level (pCi/L)	N/A	N/A	N/A	Total Uranium 10	0 15	0 15	
<b>Normal Event</b>							
<b>99A6845.</b>							
001 014	2 4	0 118	2 42	4 938	<b>0 184</b>	0 062	East (Total)
001 015	2 58	0 134	2 19	4 904	0 024	0 002	Dissolved
002 014	2 22	0 103	2	4 323	0 051	0 01	Middle (Total)
002 015	2 41	0 085	2 31	4 805	0 016	-0 007	Dissolved
003 014	2 18	0 067	2 14	4 387	0 035	0 013	West (Total)
003 015	2 19	0 114	2 05	4 354	0 001	-0 013	Dissolved
004 014	2 23	0 106	2 49	4 826	0 114	0 098	East (Total) DUP
004 015	2 45	0 06	2 3	4 81	0 001	0 006	Dissolved
005 010	-0 003	-0 001	-0 019	0	0 007	0 013	10299 Rinsate
007 008	-0 008	-0 001	-0 017	0	-0 004	0 011	Rinsate (10699)
<b>Storm Event</b>							
<b>99A6846</b>							
001 014	-0 01	-0 002	0 001	0 001	0 001	0 018	East (MS)
001 015	-0 004	-0 002	-0 017	0	-0 001	0 011	Dissolved
002 014	0 356	0 01	0 385	0 751	0 093	0 025	East (Total)
002 015	0 278	0 009	0 264	0 551	0 034	0 027	Dissolved
003 014	0 238	0 011	0 204	0 453	0 06	0 049	Middle (Total)
003 015	0 212	0 024	0 153	0 389	0 037	-0 001	Dissolved
004 014	0 218	0 018	0 217	0 453	0 084	0 074	West (Total)
004 015	0 196	0 017	0 243	0 456	0 037	-0 004	Dissolved

### 3.0 DATA QUALITY ASSESSMENT

This section provides the results of Procedure RF/RMRS-98-200, *Evaluation of Data for Usability in Final Reports*, to indicate data usability for remediation strategies for the Bowmans Pond Investigation Area. The data evaluated by this procedure include surface soil, subsurface soil, and surface water samples analyzed for metals, semivolatile organic compounds (SVOCs), radionuclides and volatile organic compounds (VOC) collected in support of the SAP for the characterization of Bowmans Pond and IHSS 139 1N (RMRS, 1999).

#### 3.1 Precision

Precision is a measure of the reproducibility of analytical results. Precision is expressed quantitatively by the Relative Percent Difference (RPD) between real and duplicate sample results. The closer the numerical values of the measurements are to each other, the lower the RPD as defined by the following equation:

$$RPD = \frac{|C_1 - C_2|}{(C_1 + C_2)/2} \times 100$$

where

$C_1$  = Concentration of the analyte in the real sample

$C_2$  = Concentration of the analyte in the duplicate sample

Instances in which the analytical result for either sample was qualified with a "U" by the laboratory, calculating the RPD was not necessary. The data flag "U" indicates that the analyte was not present above the detection limit and the data is reproducible. The QC criterion for RPDs was  $\leq 40\%$  for soil and  $\leq 30\%$  for water samples. As can be seen in Table 3.1, two percentage deficiencies are present in soil comparisons for Chromium and Aroclor-1254 which exceed 40%. Although the absolute differences in concentrations between the real and duplicate samples for each of these analytes were significant, these concentrations are all well below their respective RFCA Tier II action levels and could

likely be reproduced at similarly low levels The mean RPD was 22.2% for soils and 2.3% for water, well within their respective precision compliance percentages

**Table 3.1 1999 Exceedances in RPD for Non-Radiological Data**

Real Sample ID	Associated QC Sample ID	QC Sample Type	Media	Detected Analyte	Real Sample Result	QC Sample Result	RPD Value
99A6848-002	99A6848-012	Duplicate	Sediment	Chromium	5.5 mg/Kg	12.3 mg/Kg	76.40%
99A6848-002	99A6848-012	Duplicate	Sediment	Aroclor-1254	73 ug/Kg	180 ug/Kg	84.58%

For radiological analytes, the normalized absolute difference between real and duplicate sample results is expressed by calculating the Duplicate Error Ratio (DER), given by the relationship below. This is used in testing the null hypothesis that the results do not differ significantly when compared to their respective Total Propagated Uncertainty (TPU).

$$DER = \frac{|S - D|}{\text{Square Root } (TPU_s^2 + TPU_d^2)}$$

where

$TPU_s$  = Total Propagated Uncertainty of the real sample (Total Error)

$TPU_d$  = Total Propagated Uncertainty of the duplicate sample (Total Error)

S = Real sample result

D = Duplicate sample result

If the DER is greater than 1.96, the corresponding sample results should be qualified as "J", as at the 5% level of significance, and the conclusion can be made that the real and duplicate samples differ. As can be seen from Table 3.2, in only one instance did the DER exceed the above criterion. Real and duplicate samples 99A6848-003 and 013 had reported Pu-239/240 activities of 0.334 and 1.480 pCi/g, respectively, resulting in a DER of 2.5. Although the absolute difference in values between these activities is significant, neither of these values exceed their respective RFCA Tier II action level of 252 pCi/g for surface soils. It can therefore be determined that this exceedance in the DER is of no concern and that it is likely this data is reproducible at similarly low levels.



**Table 3.2 1999 Exceedances in DER for Radiological Data**

Real Sample ID	Associated QC Sample ID	QC Sample Type	Media	Detected Analyte	Real Sample Result	QC Sample Result	Duplicate Error Ratio
99A6848-003	99A6848-013	DUP	Sediment	Pu-239/240	0.334 pCi/g	1.48 pCi/g	2.5

### 3.2 Accuracy

Accuracy is a measure of how closely an analytical or survey result corresponds to the "true" concentration or activity in a sample. Systematic uncertainties that affect accuracy, also known as bias, are also included under this section.

#### Radiological Surveys (RFETS-specific procedures)

Accuracy of radiological surveys is satisfactory based on annual calibrations of instrumentation and daily source checks that must perform within specified tolerances (+/-20%) as specified in the *Radiological Safety Practices*.

#### Laboratory Alpha Spectrometry and Tritium Analyses

All alpha spec data were acceptable without qualification as were the analyses for Tritium.

#### VOC (EPA 8260)

Matrix Spike (MS) samples collected for soil samples were within the specific requirements except for one sample # VBKCK. The MS sample recovery for this sample was below the 59-125% range for 1,1 Dichloroethene and was therefore of low bias. However, since this contaminant is not a contaminant of concern, there is no impact to the remaining analytes.

Several blanks were contaminated with VOCs (specifically Methylene Chloride and Acetone) but were below the Contract Required Detection Limits (CRDL) and are considered laboratory contamination. Blank contamination did not impact project decisions (e.g., waste management, H&S, etc).

### **SVOC (EPA 1311/3510/8270)**

Several MS recoveries for various analytes were out of specified tolerances, but did not impact the contaminants of concern. Therefore, accuracy of SVOCs is adequate for the contaminants of concern for the project.

### **PCBs (EPA 8081)**

Due to the relatively high concentration of target analytes in the soil, the laboratory had to dilute the samples and thus MS and MSD were not attainable for the various aroclors. The reporting limits were adjusted to take into account the dilution.

Six out of 66 blank recoveries criteria and eight of the 50 surrogate recoveries were outside of the acceptance criteria for the project. However, these analytes are not contaminants of concern (Aroclor-1254) and do not impact Accuracy for the project.

### **Metals (TCLP, Total, and Mercury; EPA 1311/6010 & 7470)**

With the exception of the qualified results discussed below, accuracy of metals results is adequate based on the following analytical quality controls:

- Initial calibration and continuing calibration of the measuring instrumentation,
- Interference check samples,
- Serial dilutions,
- Lab control samples (LCS),
- Blank results (preparation and TCLP)

Six Matrix spike samples and seven Matrix spike duplicates were not within the specified range of 75-125%. These analytes however, were not contaminants of concern and therefore, Accuracy for the metal data for this project is acceptable.

### 3.3 Representativeness

Investigative samples were collected in accordance with the SAP (RMRS, 1999) as summarized in Table 3.3. Due to practical refusal during sampling, four of the 11 boreholes could not be completed to the total depth as planned in the SAP. This deviation from the SAP is justifiable as the analytical data from the overlying interval (0.5 to 1.5 ft) is adequate to characterize subsurface soil and thus is representative of the subsurface soil conditions at those borehole locations. No additional sampling is required.

**Table 3.3 Sample Comparison (Required-vs-Actual)**

	Required Number of Samples per SAP	Actual Number of Samples Collected	Deviation	Justification
<b>Surface Soils</b>				
Radionuclides	11	11	0	
Pesticides and PCBs	11	11	0	
Metals	11	11	0	
SVOCs	11	11	0	
VOCs	11	11	0	
PH	2	2	0	
<b>Subsurface Soils</b>				
Radionuclides	22	18	4	Total sample depth not reached due to refusal during sampling
Pesticides and PCBs	22	18	4	Total sample depth not reached due to refusal during sampling
Metals	22	18	4	Total sample depth not reached due to refusal during sampling
SVOCs	22	18	4	Total sample depth not reached due to refusal during sampling
VOCs	22	18	4	Total sample depth not reached due to refusal during sampling
<b>Surface Water</b>				
Radionuclides	6	6	0	
Pesticides and PCBs	6	6	0	
Metals	6	6	0	
SVOCs	6	6	0	
VOCs	6	6	0	
Oil and Grease	6	6	0	
Nitrate+nitrite as N	6	6	0	

### **3.4 Completeness**

A completeness goal of 90% was set for the project per the SAP (RMRS, 1999). The completion goal means that 90% of the data collected, analyzed, and verified is of acceptable quality for decision making. Soil samples analyzed for pesticides and PCBs were extracted one day after their required holding time. However, these sample data are considered representative and comparable and will be used as true detections for Aroclor-1254. Real samples and QC samples were reviewed for the data usability and achievement of internal DQO usability goals. The project achieved a completeness of 100%.

### **3.5 Comparability**

Analytical results from the three surface water locations (west, center, and east locations) during a normal base level condition are comparative and consistent with sample collection activities and were performed in accordance with the SAP and the procedures described in Section 2.3 (above). Analytical results from the three surface water locations (west, center, and east locations) during a storm water runoff event are comparative and consistent with sample collection activities and were performed in accordance with the SAP and the procedures described in Section 2.3 (above). The two unique data sets, one set collected during a normal base level condition, and one set from a storm water runoff event are comparable and sufficient to characterize surface water conditions during April 1999.

Surface soil (0.0 to 0.5 ft) analytical results from the eleven borehole locations are comparative and consistent with sample collection activities and were performed in accordance with the SAP and procedures described in Section 2.2 (above). Subsurface soil (greater than 0.5 ft) analytical results from the eleven borehole locations are comparative and consistent with sample collection activities and were performed in accordance with the SAP and procedures described in Section 2.2 (above).

**Comparison of Environmental Samples with Blanks (Quality Control Samples)**

Common laboratory contaminants were identified in equipment rinsate blanks, trip blanks, and in laboratory duplicate and control samples. These are Bis(2-Ethylhexyl)Phthalate, acetone, and methylene chloride. Table 3.4 presents the quality control sample summary. The laboratory case narratives note that acetone and methylene chloride concentrations are less than two times the Contract Required Quantitation Limits (CRQL). If the concentration of a common laboratory contaminant is less than ten times the blank concentration, then it can be concluded that the chemical was not detected in the sample and the blank related concentrations are the quantitation limit for the chemical in that sample (US EPA, 1989). Therefore, detections of these analytes are considered a result of laboratory contamination. Analyte detections that are not common laboratory contaminants are considered true detects (US EPA, 1989).

The maximum concentrations of methylene chloride and acetone detected in the laboratory blanks were 9 and 12 µg/kg, respectively. Neither of these contaminants were detected at greater than ten times the blank concentration except for one sample from BH10999. At this location, acetone was reported in sample number 99A6848-036 001 at a concentration of 390 µg/kg from the 1.5 – 2.0 ft bgs interval. The RFCA Tier II action levels for methylene chloride and acetone in industrial use surface soils are 763,000 and  $2.04 \times 10^8$  µg/kg, respectively. The maximum values of detectable levels for methylene chloride and acetone reported in soils is 21 and 390 µg/kg, respectively (well below the Tier II action levels). The quality control (QC) samples for the project consisted of a 1 in 20 frequency for duplicate samples and equipment rinsates. Duplicate samples were collected on a frequency of one duplicate sample for every twenty real samples. Rinsate samples were collected at a frequency of one rinsate sample for every 20 real samples collected and trip blanks were collected at a frequency of one trip blank for every 20 real VOC samples (Table 3.5). Detections not associated with a trip blank will be considered real.

Table 3.4 QC Sample Summary

QC Sample ID/Analyte	QC Sample Type	QC Sample Date	Assoc	Real Sample	Real Sample Date	QC Sample Result	Units	Real Sample Result	Units	Detect in Blank (yes/no)
99A6845-005 002/Bis(2-ethylhexyl)phthalate	Rinse	4/21/99	99A6847-001 010		4/20/99	2	ug/l	1	ug/kg	yes
99A6845-005 002/ acetone	Rinse	4/21/99	99A6848-006 002		4/20/99	2	ug/l	19	ug/kg	yes
99A6845-007 002/ acetone	Rinse	4/20/99	99A6848-010 002		4/20/99	4	ug/l	18	ug/kg	yes
99A6845-007 002/ methylene chloride	Rinse	4/20/99	99A6848-010 002		4/20/99	3	ug/l	6	ug/kg	yes
99A6845-006 001/ acetone	Trip	4/28/99	99A6848-010 002		4/20/99	33	ug/l	18	ug/kg	yes
99A6845-006 001/ methylene chloride	Trip	4/28/99	99A6848-010 002		4/20/99	3	ug/l	6	ug/kg	yes
99A6846-001 006/ acetone	Rinse	4/22/99	99A6846-002 011		4/22/99	5	ug/l	9	ug/kg	yes
99A6846-001 006/ methylene chloride	Rinse	4/22/99	99A6846-002 011		4/22/99	5	ug/l	5	ug/kg	yes
99A6845-006 001/ acetone	Trip	4/28/99	99A6848-018 001		4/26/99	33	ug/l	25	ug/kg	yes
99A6845-006 001/ methylene chloride	Trip	4/28/99	99A6848-018 001		4/26/99	3	ug/l	7	ug/kg	yes
99A6845-006 001/ acetone	Trip	4/28/99	99A6848-019 001		4/26/99	33	ug/l	12	ug/kg	yes
99A6845-006 001/ methylene chloride	Trip	4/28/99	99A6848-019 001		4/26/99	3	ug/l	6	ug/kg	yes
99A6845-006 001/ acetone	Trip	4/28/99	99A6848-020 001		4/26/99	33	ug/l	8	ug/kg	yes
99A6845-006 001/ methylene chloride	Trip	4/28/99	99A6848-020 001		4/26/99	3	ug/l	5	ug/kg	yes
99A6845-006 001/ acetone	Trip	4/28/99	99A6848-021 001		4/26/99	33	ug/l	11	ug/kg	yes
99A6845-006 001/ methylene chloride	Trip	4/28/99	99A6848-021 001		4/26/99	3	ug/l	6	ug/kg	yes
99A6845-008 001/ acetone	Trip	4/29/99	99A6848-023 001		4/27/99	32	ug/l	12	ug/kg	yes
99A6845-008 001/ methylene chloride	Trip	4/29/99	99A6848-023 001		4/27/99	3	ug/l	11	ug/kg	yes
99A6845-008 001/ acetone	Trip	4/29/99	99A6848-025 001		4/27/99	32	ug/l	10	ug/kg	yes
99A6845-008 001/ methylene chloride	Trip	4/29/99	99A6848-025 001		4/27/99	3	ug/l	6	ug/kg	yes

**Table 3 5 QC Sample Type and Quantity**

Sample Type	Number of Investigative Samples	Number of QC Samples
Duplicate	35	3
Rinse Blank	35	3
Trip Blank (VOA only)	24	3

### **3.6 Summary**

Based on the evaluation of the data in accordance with Procedure RF/RMRS-98-200, *Evaluation of Data for Usability in Final Reports*, the data contained herein is usable for the Bowmans Pond Investigation Area. Data collected in support of this project comply with the RMRS Quality Assurance Program Description RMRS-QAPD-001, rev 2, 4/15/98 (RMRS, 1998) which is consistent with the K-H Team QA Program (K-H, 1997). The RMRS QA Program is consistent with quality requirements and guidelines mandated by the EPA, CDPHE and DOE.

## **4.0 CONCLUSIONS AND RECOMMENDATIONS**

Prior to this investigation, data from previous investigations, and general process knowledge of the Bowmans Pond soil and sediment (and surrounding areas including IHSS 139 1N) indicated that the Sites were potentially contaminated. Broken Original Process Waste Lines, Under Building Contamination (UBC) concerns and adjacent IHSSs within and surrounding Buildings 771 and 774 presented potential contaminant sources to the area. Further, the foundation and storm drains from the nearby buildings provide inflow to Bowmans Pond and may be a potential migration pathway for contaminants in the future.

Upon review of available information and final analysis gathered from this investigation, several conclusions have been made. These are as follows:

- The Bowmans Pond sediments and surrounding soils (including those associated with IHSS 139 1N) are not as contaminated as first thought. There were no compounds identified at or above the RfCA Tier I surface and subsurface soil action levels.

- Polychlorinated Biphenyl (PCB) contamination above Tier II surface and subsurface action levels (Aroclor-1254) is evident in the drainage upgradient of Bowmans Pond (SED 124 and BH10499) and within the sediments of the pond and depositional area at nearly identical concentrations (and locations) as observed in 1991
- Radionuclide concentrations in soil and sediments are one to two orders of magnitude below the RFCA Tier II surface and subsurface soil action levels and using the Tier II sum of ratios methodology. Based upon this finding, no remedial actions are required for radionuclides
- Core logging of sediment from each of the eleven sampling locations reveal that Bowmans Pond sediments are approximately 4 feet thick near the center of the pond and between 1 and 2 feet thick at influent and effluent areas. The core logs show that sediments within the investigation area are composed of between 3 inches to 10 feet of organic matter over approximately one to two feet of gravelly silt and/or silty clay. Silty and highly plastic clays were predominantly observed from approximately 2 feet to the total depth of the boreholes. Outside of the pond, water levels ranged from 0 to 2 inches above ground surface. Water depth at borehole locations along the edge of the pond ranged from 0 to 2 inches (above sediment) to 1.9 feet at the pond's center. The core logs are included in Attachment 1.
- Soil and sediments within IHSS 139 1N are not contaminated with PCOCs identified from the Bowmans Pond surface water, contaminants associated with steam condensate water stored in Tanks T-107 and T-108, or from the bermed sodium hydroxide tank located immediately adjacent to Building 774.
- Concentrations of carbon tetrachloride in surface water from Bowmans Pond exceed the RFCA action level of 0.005 mg/L for surface water. Although a source has not been clearly identified, it appears that upgradient groundwater contaminated with carbon tetrachloride is entering the Building 771 and/or 774 footing drains (probably from IHSS 118 1). A portion of the groundwater and surface water from the investigation area (north of the condensate tanks) is captured by the Solar Ponds.



**ATTACHMENT 1**  
**1999 ANALYTICAL DATA**